6.2/17

$$\int \frac{x^5+2x^2-1}{x^4}\,dx$$

No magic
What do you know?

$$\int x^n\,dx = \frac{x^{n+1}}{n+1}+C$$

$$= \int \frac{x^5}{x^4}\,dx + \int \frac{2x^2}{x^4}\,dx - \int \frac{1}{x^4}\,dx$$

$$= \int x^1\,dx + 2\int x^{-2}\,dx - \int x^{-4}\,dx$$

$$= \frac{x^2}{2} + 2\left(-\frac{1}{x}\right) - \left(-\frac{1}{3}x^{-3}\right) + C$$

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6.2/23

$$\int \sec x(\sec x + \tan x)\,dx$$

A 1

CLASSIC.

$$= \int \sec^2 x\,dx + \int \sec x \tan x\,dx$$

This is for You Justina!

$$= \tan x + \sec x + C$$

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6.2/24 $\int \sec x(\tan x + \cos x)\,dx$

$= \int \sec x \tan x\,dx + \int \sec x \cos x\,dx$

$= \sec x + \int \frac{1}{\cos x}(\cos x)\,dx$

$= \sec x + \int 1\,dx = \sec x + x + C$

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6.3 Integration by Substitution

aka "Integration meets the chain rule"

Justina-note "also known as"

what is the derivative of $\sin(x^3)$?

$$\frac{d}{dx}\left(\sin(x^3)\right) = \cos(x^3)\cdot(3x^2)$$

$$\text{So } \int 3x^2\cos(x^3)\,dx = \sin(x^3)+C$$

6.3 - integration by substitution

Find $\int 3x^2 \cos(x^3)\,dx$ if you don't see the answer right away.

Recall the chain rule

$$\frac{d}{dx}\left(f(g(x))\right) = f'(g(x)) \cdot g'(x)$$

So $\int f'(g(x)) \cdot g'(x)\,dx = f(g(x)) + C$

integration by substitution:

$$\int f'(g(x))\, g'(x)\,dx$$

u will be a function I treat as a new variable

Convert to differential talk

Let $u = g(x)$

$\frac{du}{dx} = g'(x)$

$du = g'(x)\,dx$

THEN replace "$g'(x)\,dx$" in the original ONCE with "du"

AND replace EVERY "$g(x)$" with "u"

$$\Rightarrow \int f'(u)\,du = f(u) + C$$

$$= f(g(x)) + C$$

replace u with $g(x)$

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$$\int 3x^2 \cos(x^3)\,dx$$

Think 2 yourself:

I know $\int \cos u\,du$

Let $u = x^3$

$\frac{du}{dx} = 3x^2$

$\Rightarrow \boxed{du = 3x^2\,dx}$

$\Rightarrow \int \cos(u)\,du = \sin u + C = \sin(x^3) + C$

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Think of (for now)

$\int (\quad) dx$ as calculus parentheses

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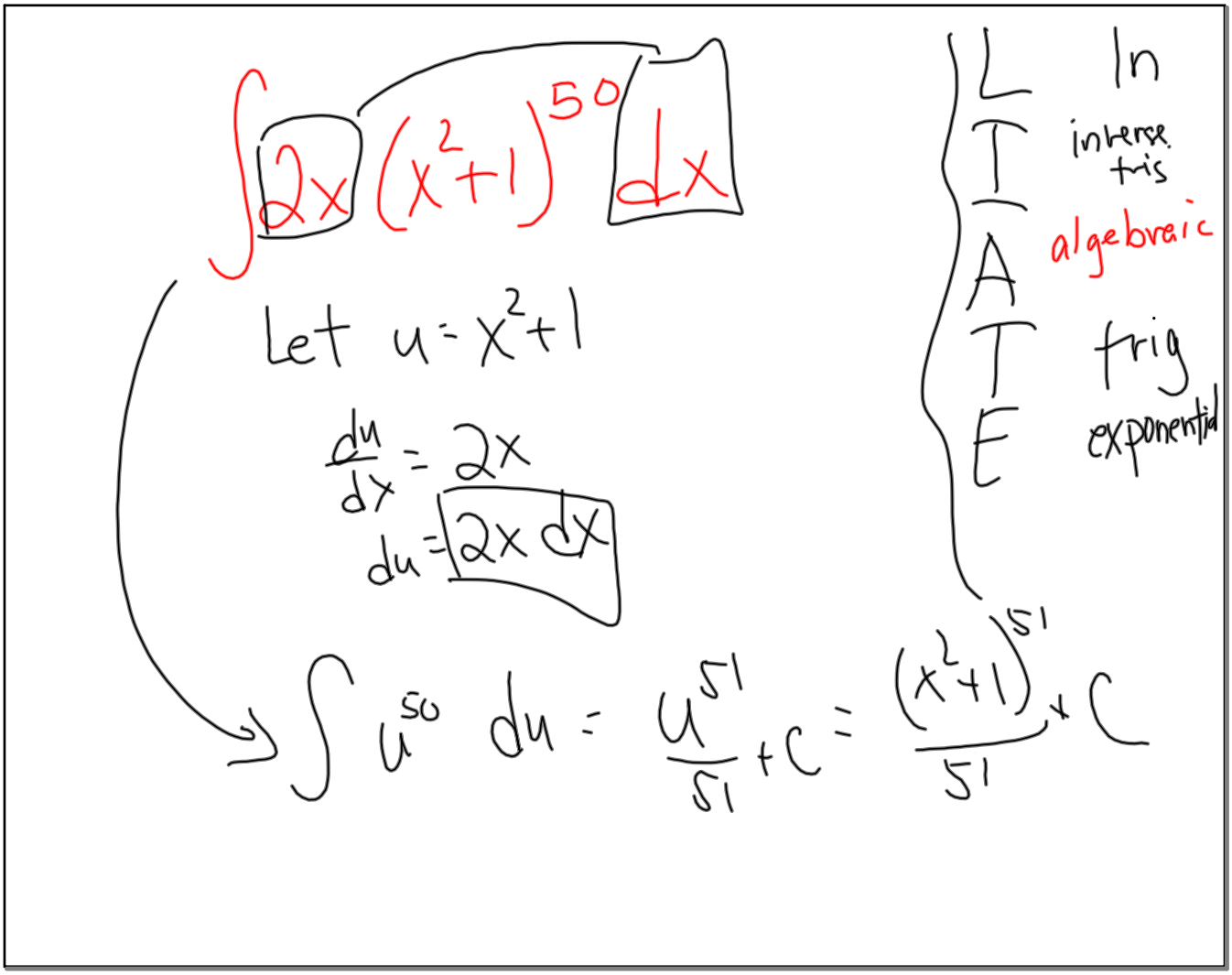
$\int 2x\,(x^2+1)^{50}\,dx$
Let $u = x^2+1$
$\frac{du}{dx} = 2x$
$du = 2x\,dx$
$\int u^{50}\,du = \frac{u^{51}}{51} + C = \frac{(x^2+1)^{51}}{51} + C$
LIATE
ln
inverse trig
algebraic
trig
exponential